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(54) Abstract Title  
**Water-soluble container with gas release means**

(57) A water-soluble container containing a chemical composition which generates a gas has a gas release means such as one or more vent holes or a permeable wall section. The container may be formed by injection moulding or thermoforming. The composition may comprise a bleach. The container may comprise two compartments separated by a water-permeable wall (eg of poly (vinyl alcohol)). The first compartment may contain a first composition (eg detergent) comprising water and the second compartment may contain a composition (eg comprising a bleach) which generates a gas when contacted with the first composition, the second compartment having the gas release means.

IMPROVEMENTS IN OR RELATING TO CONTAINERS

The present invention relates to a water-soluble container and to a process for the preparation of such a  
5 container.

It is known to package chemical compositions, particularly those which may be of a hazardous or irritant nature, in films, particularly water soluble  
10 films. Such containers can simply be added to water in order to dissolve or disperse the contents of the container into the water.

For example, WO 89/12587 discloses a package which  
15 comprises an envelope of a water soluble material which comprises a flexible wall and a water-soluble heat seal. The package may contain an organic liquid comprising, for example, a pesticide, fungicide, insecticide or herbicide.

20 WO 92/17382 discloses a package containing an agrochemical comprising a first sheet of non-planar water-soluble or water-dispersible material and a second sheet of water-soluble or water-dispersible material  
25 superposed on the first sheet and sealed to it.

Such arrangements have, however, a number of difficulties. In particular, the packages cannot contain compositions which generate a gas because the gas  
30 inflates the packages, particularly if they are flexible, and bursts them. Such packages are especially susceptible to bursting at weak points such as the seals.

We have surprisingly found that this problem may occur even with compositions which are not normally considered to generate a gas. For example it can occur with compositions which generate a gas only on contacting  
5 another component if that component can permeate either the outside wall or any internal wall of the package.

The present invention provides a water-soluble container which contains a composition which generates a gas,  
10 wherein the container has a gas release means.

The containers of the present invention do not suffer from bursting due to the internal generation of a gas because the gas is allowed to escape into the surrounding  
15 atmosphere. However, the composition is retained in the container until the container is dissolved in water.

The gas may be generated inside the container by a variety of means. For example the composition held  
20 inside the container may generate a gas by chemical interaction with the walls of the container. The composition may also generate a gas by interaction with one or more components of the atmosphere, especially water vapour or oxygen, which diffuse through the  
25 container walls, or by interaction with one or more components held in other parts of the container which diffuse through one or more internal walls of the container. The composition may also generate a gas by  
30 itself without any interaction with any other components, such as by decomposition, for example when exposed to high temperatures or light.

As indicated above, we have found that certain components release a gas when contacted with water. Surprisingly, this can occur even when the components are separated by a wall of a material. We have, in particular, found that  
5 some materials used as walls of water-soluble containers may not be completely water-impermeable, but may have a degree of water-permeability. While the degree of water-permeability may be slight, it may be sufficient to allow a small amount of water to permeate through the wall.  
10 Since water-soluble containers may be stored for some time, for example for several months or even years, a gas may gradually be generated by contact of another component with this water, which may consequently cause the container to burst. The container may burst by means  
15 of a tear through the wall or by failure of a seal. It may also burst internally, allowing different compositions held within the container to mix.

The gas may be any gas but is usually one or more of O<sub>2</sub>,  
20 CO<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub>, HCl or the volatile ingredients of a fragrance.

The present invention is particularly suitable for a container which comprises at least a first compartment  
25 and a second compartment (and possible further compartments) separated from said first compartment by a water-permeable wall, wherein said first compartment contains a first composition, especially a component comprising water, and the second compartment contains a  
30 second composition which generates a gas when contacted with the first composition. In this instance the second compartment is provided with the gas release means.

The term "water-soluble" is taken to include water dispersible.

5 The gas release means may take any form which allows the escape of gas generated inside the container. For example it may take the form of a vent. A vent may comprise a one-way valve, for example one or more holes covered with one or more flaps. Most desirably, however,  
10 it is simply one or more holes. Desirably a single hole is provided, although an array, either regular or irregular, may also be provided. Suitably the hole or holes each have a maximum dimension of 0.1 to 2 mm. The maximum dimension is the diameter of the hole if the hole  
15 is circular. Preferably the hole or holes have a maximum dimension of 0.2 to 1.5 mm, especially about 0.5 to 1 mm, more especially about 0.8 mm. The vent may be provided simply by forming a hole or holes in the container, for example by use of a needle. Other means such as a laser,  
20 a strong gas beam or a projectile such as a particle may also be used. The hole or holes are generally provided after the container has been formed, although it may also be provided earlier in the process if desired. It is also possible to include a hole or holes at the time of  
25 forming the container, for example by providing a mould with means of an appropriate shape to form the hole or holes at the same time that the container is formed.

The gas release means may also, for example, comprise a  
30 permeable wall or wall section of the container. An example is a permeable wall or wall section which has microchannels therein. Such microchannels can be formed

by any means. For example they may be provided by the inclusion of particles in the wall or wall section which provide the permeability. Suitable particles are polyethylene, polypropylene or starch particles.

5 Desirably the particles are water-soluble. These particles are simply included in the polymer composition which is used to form the walls of the container. Such particles can be included by, for example, using a bi-injection moulding process. In general the particles  
10 have a diameter of at least the wall thickness, or the amount of particles included should be such that agglomerates form.

Another possibility is to use a polymer which has a  
15 natural gas permeability to constitute one or more walls, or parts of walls, of the container. It is, of course, necessary that the polymer is permeable to the gas being generated inside the container. An example of such a polymer is a cellulose derivative.

20

A further possibility is to generate a gas pressure sensitive membrane, for example comprising areas of weakness in the container designed to open as the gas pressure rises in the container. Areas of weakness can  
25 easily be generated by, for example, pressing a dimpled stamp onto the surface.

The containers of the present invention can be formed by any suitable method. Thus they can, for example, be  
30 formed by injection moulding, blow moulding, vertical form fill sealing, thermoforming or vacuum forming.

Thus the present invention also provides a process for preparing a container as defined above which comprises forming an open container, filling the container with the composition and sealing the container, wherein the  
5 container has a gas release means.

The container of the present invention can simply have one compartment or two or more compartments. For example it can comprise an outer compartment enclosing a  
10 composition containing a component capable of generating a gas and an inner compartment containing a composition which interacts with the component which generates a gas, for example a composition comprising water.

15 The containers which contain two or more compartments or composition can have a particularly attractive appearance because they contain two compositions, which are advantageously held in a fixed position in relation to each other. The compositions can be easily  
20 differentiated to accentuate their difference. For example, the compositions can have a different physical appearance, or can be coloured differently. Thus, for example, the containers can have an appearance of a fried egg or eyeball.

25 Such a container may contain two components which are incompatible with each other. It may also contain a component which is incompatible with the part of the container enclosing the other component. For example,  
30 one composition may be incompatible with the part of the container enclosing another composition.

The inner compartment may be fixed to the outer compartment, or may be free. Such containers can be produced by any method, for example by forming the outer compartment, filling it with the desired composition and  
5 the pre-prepared inner compartment, and then sealing the outer compartment. The outer compartment and the inner compartment can be produced by any method. Examples of suitable methods by which each compartment may be independently prepared are vertical form fill sealing,  
10 thermoforming and injection moulding.

It is also possible to produce containers in which the two or more compartments are held in a fixed spatial relationship to each other. Such containers may be  
15 prepared by, for example, thermoforming or injection moulding, or a combination thereof.

The container of the present invention may have at least two compartments, for example 2, 3 or 4 or more. At  
20 least one of the compartments may, for example, contain a composition which comprises water. The composition may comprise any amount of water such that at least some, over time, permeates through the internal wall of the container. Another compartment of the container  
25 comprises a component which generates a gas, for example when it is contacted with the water permeating through the wall. Examples of such components are bleaches, for example oxygen bleaches or chlorine bleaches. Other examples are effervescent systems, which may be single  
30 component systems or multi-component systems such as a mixture of an acid such as citric acid and a carbonate or bicarbonate such as sodium bicarbonate



For a multi-compartment container, it is possible to ensure that the components are released at different times. Thus, for instance, one composition can be released immediately the container is added to water, whereas the other may be released later. This may be achieved by having a compartment which takes longer to dissolve surrounding one of the compositions. This may be achieved, for example, by having different compartment wall thicknesses. Alternatively, the one composition may simply be held on the outside of the container, for example on the receptacle part or on the sealing member, in which case it can start to dissolve as soon as the article is added to water. It may also be achieved by choosing compartment walls which dissolve at different temperatures, for example the different temperatures encountered during the cycle of a laundry or dish washing machine.

Injection moulding can, for example, be used to form a container, which is then filled with the desired composition and sealed, for example with a film or injection-moulded rigid closure. Desirably the film or closure dissolves before the rest of the container to release the composition. It is possible to incorporate more than one compartment in the container by use of a suitably shaped injection mould.

The walls of the injection moulded container generally have a thickness greater than 100µm, for example greater than 150µm or greater than 200µm, 300µm, 500µm, 750µm or 1mm. Desirably, however, the walls have a thickness of

from 200 to 1500 $\mu$ m, preferably 300 $\mu$ m to 800 $\mu$ m. If different compartments having different dissolution times are required, different wall thicknesses for each compartment may be used. A thickness difference of from  
5 100 $\mu$ m to 500 $\mu$ m, preferably 250 $\mu$ m to 350 $\mu$ m, would give a suitable difference in release times.

A preferred polymer which is already in a form suitable for injection moulding is a poly(vinyl alcohol) (PVOH)  
10 sold in the form of granules under the name CP1210T05 by Soltec Development S.A. Paris, France. A PVOH may be moulded at temperatures of, for example, from 180 to 220°C, depending upon the formulation selected and the melt flow index required.

15

Containers produced by injection moulding can be provided with two or more compartments by an appropriate mould shape.

20 The container can be sealed with, for example, one or more water-soluble films or other sealing means as described below.

Thermoforming techniques have been described in, for  
25 example, WO 92/17382 and WO 00/55068. It is possible to incorporate more than one compartment by a variety of techniques, for example by the technique disclosed in WO 93/08095. It is also possible to use a film  
incorporating a second compartment or component as a  
30 closure film, or to place a previously prepared compartment or component at the bottom of a thermoforming mould before the main container is prepared.

The container may, for example, be formed of a film. The film may be a single film, or a laminated film as disclosed in GB-A-2,244,258. While a single film may  
5 have pinholes, the two or more layers in a laminate are unlikely to have pinholes which coincide.

The film may be produced by any process, for example by extrusion and blowing or by casting. The film may be  
10 unoriented, monoaxially oriented or biaxially oriented. If the layers in the film are oriented, they usually have the same orientation, although their planes of orientation may be different if desired.

15 The layers in a laminate may be the same or different. Thus they may each comprise the same polymer or a different polymer.

In a thermoforming or vacuum forming process an initial  
20 pocket is formed to contain the composition. The thickness of the film used to produce the pocket is preferably 40 to 300  $\mu\text{m}$ , more preferably 80 to 200  $\mu\text{m}$ , especially 100 to 160  $\mu\text{m}$ , more especially 100 to 150  $\mu\text{m}$  and most especially 120 to 150  $\mu\text{m}$ . For example, in a  
25 thermoforming process the film may be drawn down or blown down into a mould. Thus, for example, the film is heated to the thermoforming temperature using a thermoforming heater plate assembly, and then drawn down under vacuum or blown down under pressure into the mould. Plug-  
30 assisted thermoforming and pre-stretching the film, for example by blowing the film away from the mould before thermoforming, may, if desired, be used. One skilled in

the art can choose an appropriate temperature, pressure or vacuum and dwell time to achieve an appropriate pocket. The amount of vacuum or pressure and the thermoforming temperature used depend on the thickness  
5 and porosity of the film and on the polymer or mixture of polymers being used. Thermoforming of PVOH films is known and described in, for example, WO 00/55045.

A suitable forming temperature for PVOH or ethoxylated  
10 PVOH is, for example, from 90 to 130°C, especially 90 to 120°C. A suitable forming pressure is, for example, 69 to 138kPa (10 to 20 p.s.i.), especially 83 to 117 kPa (12 to 17 p.s.i.). A suitable forming vacuum is 0 to 4 kPa (0 to 40 mbar), especially 0 to 2 kPa (0 to 20 mbar). A  
15 suitable dwell time is, for example, 0.4 to 2.5 seconds, especially 2 to 2.5 seconds.

While desirably conditions chosen within the above ranges, it is possible to use one or more of these  
20 parameters outside the above ranges, although it may be necessary to compensate by changing the values of the other two parameters.

It is possible, if desired, to place a secondary  
25 component in the cavity of a thermoforming mould before the container is formed in the usual way in the mould. The secondary component can stick to the container. The secondary component may, for example, be a compressed particulate solid or a container containing a secondary  
30 composition. A suitable container comprises a polymeric film containing a particulate solid, a gel or a liquid. It is especially desirable in the context of the present

invention that the secondary component comprises a bleach and, if it is in the form of a container enclosing the bleach, is provided with the gas release means.

- 5 The compartment is then filled with the desired composition. The compartment may be completely filled or only partially filled. The composition may be a solid. For example, it may be a particulate or granulated solid, or a tablet. It may also be a liquid, which may be
- 10 thickened or gelled if desired. The liquid composition may be non-aqueous or aqueous, for example comprising less than or more than 5% total or free water. The composition may have more than one phase. For example it may comprise an aqueous composition and a liquid
- 15 composition which is immiscible with the aqueous composition. It may also comprise a liquid composition and a separate solid composition, for example in the form of a ball, pill or speckles.
- 20 The walls of the container may comprise a PVOH. Such polymers are generally considered to be water-soluble, depending on their degree of hydrolysis. However, they are known to be able to contain compositions comprising water if steps are taken to ensure that the composition
- 25 does not dissolve the PVOH or if the composition contains only a small amount of water. For example, compositions comprising up to about 5 wt% free water can be held in a PVOH container without any additional steps to protect the PVOH. Compositions comprising more than 5 wt% water
- 30 can also be held in such a container so long as steps are taken to ensure that the water is not generally able to attack the PVOH, for example by adding an electrolyte to

the composition, by gelling the composition or by coating the PVOH to stop the water from contacting the container walls. Similar precautions can be taken for other water-soluble polymers.

5

After the compartment has been filled, a sealing member is may be placed on top of the compartment and sealed thereto.

- 10 The sealing member may be produced by, for example, injection moulding or blow moulding. It may also be in the form of a film.

- The sealing member may simply consist of a water-soluble  
15 polymer. If it is desired to produce a multi-compartment container, in an embodiment of this invention the sealing member comprises a second composition at the time it is placed on top of the first compartment. This may be held or otherwise adhered on the sealing member. For example  
20 it can be in the form of a solid composition such as a ball or pill held on the sealing member by an adhesive or mechanical means. This is especially appropriate when the sealing member has a degree of rigidity, such as when it has been produced by injection moulding. It is also  
25 possible for a previously prepared container containing the second composition to be adhered to the sealing member. For example, a sealing member in the form of a film may have a filled compartment containing a composition attached thereto. The second composition or  
30 compartment may be held on either side of the sealing member such that it is inside or outside the first compartment.

Generally, however, the second composition is held within a second compartment in the sealing member. This is especially appropriate when the sealing member is flexible, for example in the form of a film.

The sealing member is placed on top of the first compartment and sealed thereto. For example the sealing member in the form of a film may be placed over a filled pocket and across the sealing portion, if present, and the films sealed together at the sealing portion. In general there is no or only one second compartment or composition in or on the sealing member, but it is possible to have more than one second compartment or composition if desired, for example 2 or 3 second compartments or compositions.

The second compartment in the sealing member may be formed by any technique. For example it can be formed by vertical form fill sealing the second composition within a film, such as by the process described in WO 89/12587. It can also be formed by having an appropriate shape for an injection moulding.

However, it is preferred to use a vacuum forming or thermoforming techniques, such as that previously described in relation to the first compartment of the container of the present invention. Thus, for example, a pocket surrounded by a sealing portion is formed in a film, the pocket is filled with the second composition, a film is placed on top of the filled pocket and across the sealing portion and the films are sealed together at the

sealing portion. In general, however, the film placed on top of the filled pocket to form the second compartment does not itself comprise a further compartment.

5 Further details of this thermoforming process are generally the same as those given above in relation to the first compartment of the container of the present invention. All of the above details are incorporated by reference to the second compartment, with the following  
10 differences:

The second compartment is generally smaller than the first compartment since the film containing the second composition is used to form a lid on the pocket.

15 Generally the second compartment does not extend across the sealing portion.

In general in any multi-compartment container of the present invention, the first compartment and the second  
20 compartment (or composition if not held within a compartment) have a volume ratio of from 2:1 to 20:1, preferable 4:1 to 10:1. The smaller compartment may, for example, comprise a bleach and the larger compartment may, for example, comprise a composition which comprises  
25 water, such as a detergent composition.

The thickness of the film comprising the second compartment may also be less than the thickness of the film making up the first compartment of the container of  
30 the present invention, because the film is not subjected to as much localised stretching in the thermoforming step. It is also desirable to have a thickness which is



less than that of the film used to form the first compartment to ensure a sufficient heat transfer through the film to soften the base web if heat sealing is used.

- 5 The thickness of the covering film is generally from 20 to 160  $\mu\text{m}$ , preferably from 40 to 100  $\mu\text{m}$ , such as 40 to 80  $\mu\text{m}$  or 50 to 60  $\mu\text{m}$ .

This film may be a single-layered film but is desirably  
10 laminated to reduce the possibility of pinholes allowing leakage through the film. The film may be the same or different as the film forming the first compartment. If two or more films are used to form the film comprising the second compartment, the films may be the same or  
15 different. Examples of suitable films are those given for the film forming the first compartment.

The first compartment and the sealing member may be sealed together by any suitable means, for example by  
20 means of an adhesive or by heat sealing. Mechanical means is particularly appropriate if both have been prepared by injection moulding. Other methods of sealing include infra-red, radio frequency, ultrasonic, laser, solvent, vibration, electromagnetic, hot gas, hot plate,  
25 insert bonding or friction sealing and spin welding. An adhesive such as water or an aqueous solution of PVOH may also be used. The seal desirably is water-soluble if the containers are water-soluble.

- 30 If heat sealing is used, a suitable sealing temperature is, for example, 120 to 195°C, for example 140 to 150°C. A suitable sealing pressure is, for example, from 250 to

600 kPa. Examples of sealing pressures are 276 to 552 kPa (40 to 80 p.s.i.), especially 345 to 483 kPa (50 to 70 p.s.i.) or 400 to 800 kPa (4 to 8 bar), especially 500 to 700 kPa (5 to 7 bar) depending on the heat sealing machine used. Suitable sealing dwell times are 0.4 to 2.5 seconds.

One skilled in the art can use an appropriate temperature, pressure and dwell time to achieve a seal of the desired integrity. While desirably conditions are chosen within the above ranges, it is possible to use one or more of these parameters outside the above ranges, although it might be necessary to compensate by changing the values of the other two parameters.

In a further embodiment, the sealing member does not comprise the second composition at the time it is placed on top of the first component. Instead the second composition is added afterwards. Thus, for example, it may be adhered to the sealing member by means of an adhesive. It may also be adhered by mechanical means, particularly when the sealing member has a degree of rigidity, for example when it has been produced by injection moulding. Another possibility is for the sealing member to contain an indentation which is filled, either before or after sealing, by a liquid composition which is allowed to gel in-situ.

If more than one container is formed at the same time from the same sheet, the containers may then be separated from each other, for example by cutting the sealing portions, or flanges. Alternatively, they may be left

conjoined and, for example, perforations provided between the individual containers so that they can be easily separated at a later stage, for example by a consumer. If the containers are separated, the flanges may be left in place. However, desirably the flanges are partially removed in order to provide an even more attractive appearance. Generally the flanges remaining should be as small as possible for aesthetic purposes while bearing in mind that some flange is required to ensure the two films remain adhered to each other. A flange having a width of 1 mm to 8 mm is desirable, preferably 2 mm to 7 mm, most preferably about 5 mm.

It is, of course, possible to join two or more containers together to form a multi-compartment container. Such containers may comprise, for example, two or more injection moulded containers, two or more thermoformed containers or one or more injection moulded containers and one or more thermoformed containers. Such containers are desirably joined across their lids to protect the relatively weak lids from damage.

Examples of water-soluble polymers which may be used to form the containers of the present invention, especially which may be used in a single layer film or in one or more layers of a laminate or which may be used for injection moulding or blow moulding are poly(vinyl alcohol) (PVOH), cellulose derivatives such as hydroxypropyl methyl cellulose (HPMC) and gelatin. An example of a preferred PVOH is ethoxylated PVOH. The PVOH may be partially or fully alcoholised or hydrolysed. For example it may be from 40 to 100%, preferably from 70

to 92%, more preferably about 88% or about 92%,  
alcoholised or hydrolysed. The degree of hydrolysis is  
known to influence the temperature at which the PVOH  
starts to dissolve in water. 88% hydrolysis corresponds  
5 to a film soluble in cold (ie room temperature) water,  
whereas 92% hydrolysis corresponds to a film soluble in  
warm water.

It is, of course, important to ensure that the  
10 composition held inside the container does not escape  
from the gas release means, particularly when it is a  
hole. If the composition is a particulate composition,  
the particle size should be greater than the maximum  
dimension of the hole. If the composition is a liquid,  
15 it should be treated such that it does not flow easily,  
for example by forming it into a gel. A gelling agent  
can, for example, be added. Suitable gelling agents are,  
for example, gums such as xanthan gum and polyacrylate  
thickeners such as those sold under the trademark  
20 Carbopol. It is also possible to coat the inside surface  
of the gas release means with a hydrophilic or lipophilic  
coating, depending on the nature of the liquid, so as to  
prevent or reduce passage of liquid therethrough.

25 The composition contained in the containers of the  
present invention may be any composition which is  
intended to be released in an aqueous environment,  
although at least one component must be capable of  
generating a gas in the finished containers. The  
30 composition may, for example, be an agrochemical  
composition such as a plant protection agent, for  
instance a pesticide such as an insecticide, fungicide,

herbicide, acaricide, or nematocide, a plant growth regulator or a plant nutrient. Such compositions are generally packaged in amounts of from 0.1 g to 7 kg, preferably 1 to 5 kg, when in solid form. When in liquid  
5 or gelled form, such compositions are generally packaged in amounts of from 1 ml to 10 litres, preferably 0.1 to 6 litres, especially from 0.5 to 1.5 litres.

The composition may also be a fabric care, surface care  
10 or dishwashing composition. Thus, for example, it may be a dishwashing, water-softening, laundry or detergent composition, or a rinse aid. Such compositions may be suitable for use in a domestic washing machine. The composition may also be a disinfectant, antibacterial or  
15 antiseptic composition, or a refill composition for a trigger-type spray. Such compositions are generally packaged in amounts of from 5 to 100 g, especially from 15 to 40 g. For example, a dishwashing composition may weigh from 15 to 30 g and a water-softening composition  
20 may weigh from 15 to 40 g.

The composition, if in liquid form, may be anhydrous or comprise water, for example at least 5 wt %, preferably at least 10 wt%, water based on the weight of the aqueous  
25 composition. Desirably the composition contains less than 80 wt% water.

The remaining ingredients of the composition depend on the use of the composition. Thus, for example, the  
30 composition may contain surface active agents such as an anionic, nonionic, cationic, amphoteric or zwitterionic surface active agents or mixtures thereof.

Examples of anionic surfactants are straight-chained or branched alkyl sulfates and alkyl polyalkoxylated sulfates, also known as alkyl ether sulfates. Such  
 5 surfactants may be produced by the sulfation of higher  $C_8$ - $C_{20}$  fatty alcohols.

Examples of primary alkyl sulfate surfactants are those of formula:



wherein R is a linear  $C_8$ - $C_{20}$  hydrocarbyl group and M is a water-solubilising cation. Preferably R is  $C_{10}$ - $C_{16}$  alkyl, for example  $C_{12}$ - $C_{14}$ , and M is alkali metal such as lithium, sodium or potassium.

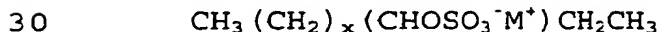
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Examples of secondary alkyl sulfate surfactants are those which have the sulfate moiety on a "backbone" of the molecule, for example those of formula:



20 wherein m and n are independently 2 or more, the sum of  $m+n$  typically being 6 to 20, for example 9 to 15, and M is a water-solubilising cation such as lithium, sodium or potassium.

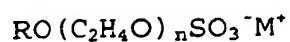
25 Especially preferred secondary alkyl sulfates are the (2,3) alkyl sulfate surfactants of formulae:



for the 2-sulfate and 3-sulfate, respectively. In these formulae x is at least 4, for example 6 to 20, preferably 10 to 16. M is cation, such as an alkali metal, for example lithium, sodium or potassium.

5

Examples of alkoxyated alkyl sulfates are ethoxylated alkyl sulfates of the formula:



10

wherein R is a  $\text{C}_8$ - $\text{C}_{20}$  alkyl group, preferably  $\text{C}_{10}$ - $\text{C}_{18}$  such as a  $\text{C}_{12}$ - $\text{C}_{16}$ , n is at least 1, for example from 1 to 20, preferably 1 to 15, especially 1 to 6, and M is a salt-forming cation such as lithium, sodium, potassium,

15 ammonium, alkylammonium or alkanolammonium. These compounds can provide especially desirable fabric cleaning performance benefits when used in combination with alkyl sulfates.

20 The alkyl sulfates and alkyl ether sulfates will generally be used in the form of mixtures comprising varying alkyl chain lengths and, if present, varying degrees of alkoxylation.

25 Other anionic surfactants which may be employed are salts of fatty acids, for example  $\text{C}_8$ - $\text{C}_{18}$  fatty acids, especially the sodium or potassium salts, and alkyl, for example  $\text{C}_8$ - $\text{C}_{18}$ , benzene sulfonates.

30 Examples of nonionic surfactants are fatty acid alkoxyates, such as fatty acid ethoxyates, especially those of formula:



wherein R is a straight or branched C<sub>8</sub>-C<sub>16</sub> alkyl group,  
5 preferably a C<sub>9</sub>-C<sub>15</sub>, for example C<sub>10</sub>-C<sub>14</sub>, alkyl group and n  
is at least 1, for example from 1 to 16, preferably 2 to  
12, more preferably 3 to 10.

The alkoxyated fatty alcohol nonionic surfactant will  
10 frequently have a hydrophilic-lipophilic balance (HLB)  
which ranges from 3 to 17, more preferably from 6 to 15,  
most preferably from 10 to 15.

Examples of fatty alcohol ethoxylates are those made from  
15 alcohols of 12 to 15 carbon atoms and which contain about  
7 moles of ethylene oxide. Such materials are  
commercially marketed under the trademarks Neodol 25-7  
and Neodol 23-6.5 by Shell Chemical Company. Other  
useful Neodols include Neodol 1-5, an ethoxylated fatty  
20 alcohol averaging 11 carbon atoms in its alkyl chain with  
about 5 moles of ethylene oxide; Neodol 23-9, an  
ethoxylated primary C<sub>12</sub>-C<sub>13</sub> alcohol having about 9 moles  
of ethylene oxide; and Neodol 91-10, an ethoxylated C<sub>9</sub>-C<sub>11</sub>  
primary alcohol having about 10 moles of ethylene oxide.

25

Alcohol ethoxylates of this type have also been marketed  
by Shell Chemical Company under the Dobanol trademark.  
Dobanol 91-5 is an ethoxylated C<sub>9</sub>-C<sub>11</sub> fatty alcohol with  
an average of 5 moles ethylene oxide and Dobanol 25-7 is  
30 an ethoxylated C<sub>12</sub>-C<sub>15</sub> fatty alcohol with an average of 7  
moles of ethylene oxide per mole of fatty alcohol.



Other examples of suitable ethoxylated alcohol nonionic surfactants include Tergitol 15-S-7 and Tergitol 15-S-9, both of which are linear secondary alcohol ethoxylates available from Union Carbide Corporation. Tergitol 15-S-  
5 7 is a mixed ethoxylated product of a  $C_{11}$ - $C_{15}$  linear secondary alkanol with 7 moles of ethylene oxide and Tergitol 15-S-9 is the same but with 9 moles of ethylene oxide.

10 Other suitable alcohol ethoxylated nonionic surfactants are Neodol 45-11, which is a similar ethylene oxide condensation products of a fatty alcohol having 14-15 carbon atoms and the number of ethylene oxide groups per mole being about 11. Such products are also available  
15 from Shell Chemical Company.

Further nonionic surfactants are, for example,  $C_{10}$ - $C_{18}$  alkyl polyglycosides, such as  $C_{12}$ - $C_{16}$  alkyl polyglycosides, especially the polyglucosides. These are especially  
20 useful when high foaming compositions are desired. Further surfactants are polyhydroxy fatty acid amides, such as  $C_{10}$ - $C_{18}$  N-(3-methoxypropyl) glycamides and ethylene oxide-propylene oxide block polymers of the Pluronic type.

25

Examples of cationic surfactants are those of the quaternary ammonium type.

The total content of surfactants in the composition is  
30 desirably 0.1 to 95 wt%, especially 60 or 75 to 90 wt%. Desirably, in a laundry composition an anionic surfactant is present in an amount of 50 to 75 wt%, the nonionic

surfactant is present in an amount of 5 to 20 wt%, and/or the cationic surfactant is present in an amount of from 0 to 20 wt%. Desirably, in a dishwashing composition the anionic surfactant is present in an amount of 0.1 to 50 wt%, the non-ionic surfactant is present in an amount of 0.5 to 20 wt%, and/or the cationic surfactant is present in an amount of from 1 to 15 wt%. The amounts are based on the total solids content of the composition, i.e. excluding any solvent which may be present.

10

The composition, particularly when used as laundry washing or dishwashing composition, may also comprise enzymes, such as protease, lipase, amylase, cellulase and peroxidase enzymes. Such enzymes are commercially available and sold, for example, under the registered trade marks Esperesc, Alcalasc and Savinasc by Nova Industries A/S and Maxatasc by International Biosynthetics, Inc. Desirably the enzymes are present in the composition in an amount of from 0.5 to 3 wt%, especially 1 to 2 wt%.

The composition may, if desired, comprise a thickening agent or gelling agent. Suitable thickeners are polyacrylate polymers such as those sold under the trade mark CARBOPOL, or the trade mark ACUSOL by Rohm and Hass Company. Other suitable thickeners are xanthan gums. The thickener, if present, is generally present in an amount of from 0.2 to 4 wt%, especially 0.5 to 2 wt%.

30 Dishwasher compositions usually comprise a detergency builder. Suitable builders are alkali metal or ammonium phosphates, polyphosphates, phosphonates,

polyphosphonates, carbonates, bicarbonates, borates, polyhydroxysulfonates, polyacetates, carboxylates such as citrates, and polycarboxylates. The builder is desirably present in an amount of up to 90 wt%, preferably 15 to 90 wt%, more preferable 15 to 75 wt%, relative to the total weight of the composition. Further details of suitable components are given in, for example, EP-A-694,059, EP-A-518,720 and WO 99/06522.

- 10 The compositions can also optionally comprise one or more additional ingredients. These include conventional detergent composition components such as further surfactants, bleaches, bleach enhancing agents, builders, suds boosters or suds suppressors, anti-tarnish and anti-
- 15 corrosion agents, organic solvents, co-solvents, phase stabilisers, emulsifying agents, preservatives, soil suspending agents, soil release agents, germicides, pH adjusting agents or buffers, non-builder alkalinity sources, chelating agents, clays such as smectite clays,
- 20 enzyme stabilizers, anti-limescale agents, colourants, dyes, hydrotropes, dye transfer inhibiting agents, brighteners, and perfumes. If used, such optional ingredients will generally constitute no more than 10 wt%, for example from 1 to 6 wt%, the total weight of the
- 25 compositions.

Examples of bleaches are, for example, listed in WO 99/06522. These include oxygen releasing bleaching agent such as a hydrogen peroxide source and an organic

30 peroxyacid bleach precursor compound or a preformed organic peroxyacid. Examples of hydrogen peroxide sources are inorganic perhydrate bleaches such as the

- alkali metal salts of perborate, percarbonate, perphosphate, persulfate and persilicates. Examples of organic peroxyacid bleach precursors are listed in WO 99/06522. The bleaches also include chlorine releasing agents such as hydantoins, for example 1,3-dichloro-5,5-dimethyl hydantoin, hypochlorites such as sodium hypochlorite or dichloroisocyanurates such as sodium dichloroisocyanurate.
- 10 The builders counteract the effects of calcium, or other ion, water hardness encountered during laundering or bleaching use of the compositions herein. Examples of such materials are citrate, succinate, malonate, carboxymethyl succinate, carboxylate, polycarboxylate and
- 15 polyacetyl carboxylate salts, for example with alkali metal or alkaline earth metal cations, or the corresponding free acids. Specific examples are sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids, C<sub>10</sub>-C<sub>22</sub> fatty
- 20 acids and citric acid. Other examples are organic phosphonate type sequestering agents such as those sold by Monsanto under the trade mark Dequest and alkylhydroxy phosphonates. Citrate salts and C<sub>12</sub>-C<sub>18</sub> fatty acid soaps are preferred.
- 25 Other suitable builders are polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic and copolymers and their
- 30 salts, such as those sold by BASF under the trade mark Sokalan.

The builders generally constitute from 0 to 3 wt%, more preferably from 0.1 to 1 wt%, by weight of the compositions.

- 5 Compositions which comprise an enzyme may optionally contain materials which maintain the stability of the enzyme. Such enzyme stabilizers include, for example, polyols such as propylene glycol, boric acid and borax. Combinations of these enzyme stabilizers may also be  
10 employed. If utilized, the enzyme stabilizers generally constitute from 0.1 to 1 wt% of the compositions.

- The compositions may optionally comprise materials which serve as phase stabilizers and/or co-solvents. Example  
15 are C<sub>1</sub>-C<sub>3</sub> alcohols such as methanol, ethanol and propanol. C<sub>1</sub>-C<sub>3</sub> alkanolamines such as mono-, di- and triethanolamines can also be used, by themselves or in combination with the alcohols. The phase stabilizers and/or co-solvents can, for example, constitute 0 to 1  
20 wt%, preferably 0.1 to 0.5 wt%, of the composition.

- The compositions may optionally comprise components which adjust or maintain the pH of the compositions at optimum levels. The pH may be from, for example, 1 to 13, such  
25 as 8 to 11 depending on the nature of the composition. For example a dishwashing composition desirably has a pH of 8 to 11, a laundry composition desirable has a pH of 7 to 9, and a water-softening composition desirably has a pH of 7 to 9. Examples of pH adjusting agents are NaOH  
30 and citric acid.

If more than one composition is present in the containers of the present invention, the compositions may be the same or different. If they are different, they may, nevertheless, have one or more individual components in  
5 common.

The containers may themselves be packaged in outer containers if desired, for example non-water soluble containers which are removed before the water-soluble  
10 containers are used.

The containers of the present invention, especially when used for a fabric care, surface care or dishwashing composition, may have a maximum dimension of 5 cm,  
15 excluding any flanges. For example, a container may have a length of 1 to 5 cm, especially 3.5 to 4.5 cm, a width of 1.5 to 3.5 cm, especially 2 to 3 cm, and a height of 1 to 2 cm, especially 1.25 to 1.75 cm.

20 In multi-compartment containers the primary composition and the secondary composition may be appropriately chosen depending on the desired use of the article.

If the article is for use in laundry washing, the first  
25 composition may comprise, for example, a detergent, and the second composition may comprise a bleach, stain remover, water-softener, enzyme or fabric conditioner. The article may be adapted to release the compositions at different times during the laundry wash. For example, a  
30 bleach or fabric conditioner is generally released at the end of a wash, and a water-softener is generally released

at the start of a wash. An enzyme may be released at the start or the end of a wash.

If the article is for use as a fabric conditioner, the first composition may comprise a fabric conditioner and the second composition may comprise an enzyme which is released before or after the fabric conditioner in a rinse cycle.

10 If the article is for use in dish washing the first composition may comprise a detergent and the second composition may comprise a water-softener, salt, enzyme, rinse aid, bleach or bleach activator. The article may be adapted to release the compositions at different times during the laundry wash. For example, a rinse aid, bleach or bleach activator is generally released at the end of a wash, and a water-softener, salt or enzyme is generally released at the start of a wash. The article may also have more than two compartments adapted to release compositions at different times. For example a three compartment container may contain a bleach, a bleach activator and an enzyme in different compartments. A four compartment container may also contain a salt in a fourth compartment.

CLAIMS

1. A water-soluble container which contains a composition which generates a gas, wherein the container  
5 has a gas release means.
2. A container according to claim 1 wherein the composition generates a gas by chemical interaction with the walls of the container.  
10
3. A container according to claim 1 wherein the composition generates a gas by interaction with one or more components of the atmosphere which diffuses through the container walls.  
15
4. A container according to claim 1 wherein the composition generates a gas without any interaction with any other components.
- 20 5. A container according to claim 4 which comprises a first compartment and a second compartment separated from said first compartment by a water-permeable wall, wherein said first compartment contains a first composition [comprising water] and the second compartment contains a  
25 second composition which generates a gas when contacted with the first composition, said second compartment having the gas release means.
6. A container according to claim 5 wherein said water-  
30 permeable wall comprises a poly(vinyl alcohol).



7. A container according to any one of the preceding claims which has outer walls comprising a poly(vinyl alcohol).

5 8. A container according to any one of the preceding claims which has been formed by thermoforming.

9. A container according to any one of claims 1 to 7 which has been formed by injection moulding.

10

10. A container according to any one of the preceding claims wherein the gas release means is a vent.

11. A container according to claim 10 wherein the vent  
15 is one or more holes.

12. A container according to claim 11 wherein each hole has a maximum dimension of 0.1 to 2 mm.

20 13. A container according to claim 12 wherein each hole has a maximum dimension of 0.5 to 1.5 mm.

14. A container according to any one of claims 1 to 9 wherein the gas release means is a permeable wall or wall  
25 section of the container.

15. A container according to claim 14 wherein the permeable wall or wall section has microchannels therein.

30 16. A container according to claim 14 or 15 wherein the permeable wall or wall section comprises particles which provide the permeability.

17. A container according to claim 16 wherein the particles are polyethylene, polypropylene or starch particles.

5

18. A container according to any one of the preceding claims wherein the composition which generates a gas comprises a bleach.

10 19. A container according to claim 18 which comprises a composition comprising water in a separate compartment from said composition which generates a gas.

20. A container according to claim 19 wherein the  
15 composition comprising water is a detergent composition.

21. A container according to any one of the preceding claims which has at least two compartments, wherein the first compartment is sealed with a sealing member which  
20 comprises the second compartment within said sealing member.

22. A container according to claim 21 wherein the sealing member is a film.

25

23. A container according to claim 22 wherein the film contains a second compartment which has been formed by a vertical form fill sealing method.

30 24. A container according to claim 22 wherein the film contains a second compartment which has been formed by thermoforming.

25. A container according to any one of the preceding claims wherein the composition which generates a gas is a particulate solid, a gel, a liquid or a compressed solid.

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26. A container according to claim 25 which comprises a second composition which is a particulate solid, a gel, a liquid or a compressed solid.

10 27. A container according to any one of the preceding claims which comprises a fabric care, surface care or dishwashing composition.

15 28. A container according to claim 27 which comprises a dishwashing, water-softening, laundry or detergent composition or a rinse aid.

20 29. A container according to claim 27 which comprises a disinfectant, antibacterial or antiseptic composition or a refill composition for a trigger-type spray.

30. A container according to any one of claims 1 to 26 which comprises an agricultural composition.

25 31. A process for preparing a container as defined in any one of the preceding claims which comprises forming an open container, filling the container with the composition and sealing the container, wherein the container has a gas release means.

30

32. A process according to claim 31 wherein the gas release means is formed by inserting a needle through the container wall or by a laser.

5 33. A process according to claim 32 wherein the laser is applied or the needle is inserted through the container wall after the container has been formed.

10 34. A process according to claim 31 wherein the gas release means is one or more holes formed at the same time as the container is formed by moulding.

Amendments to the claims have been filed as follows

1. A water-soluble container formed by injection moulding or thermorforming which contains a composition which generates a gas, wherein the container has a gas release means.
2. A container according to claim 1 wherein the composition generates a gas by chemical interaction with the walls of the container.
3. A container according to claim 1 wherein the composition generates a gas by interaction with one or more components of the atmosphere which diffuses through the container walls.
4. A container according to claim 1 wherein the composition generates a gas without any interaction with any other components.
5. A water-soluble container which comprises a first compartment and a second compartment separated from said first compartment by a water-permeable wall, wherein said first compartment contains a first composition comprising water and the second compartment contains a second composition which generates a gas when contacted with the first composition, said second compartment having a gas release means.
6. A container according to claim 5 wherein said water-permeable wall comprises a poly(vinyl alcohol).

7. A container according to claim 5 or 6 wherein the first composition comprises water in a detergent composition.
- 5 8. A container according to any one of the preceding claims wherein the component which generates a gas comprises a bleach.
- 10 9. A water-soluble container which contains a composition which generates a gas, said composition comprising a bleach, wherein the container has a gas release means.
- 15 10. A container according to any one of the preceding claims which has outer walls comprising a poly(vinyl alcohol).
- 20 11. A container according to any one of the preceding claims which has been formed by thermoforming.
12. A container according to any one of claims 1 to 10 which has been formed by injection moulding.
- 25 13. A container according to any one of the preceding claims wherein the gas release means is a vent.
14. A container according to claim 13 wherein the vent is one or more holes.
- 30 15. A container according to claim 14 wherein each hole has a maximum dimension of 0.1 to 2 mm.

16. A container according to claim 15 wherein each hole has a maximum dimension of 0.5 to 1.5 mm.
- 5 17. A container according to any one of claims 1 to 12 wherein the gas release means is a permeable wall or wall section of the container.
- 10 18. A container according to claim 17 wherein the permeable wall or wall section has microchannels therein.
- 15 19. A container according to claim 17 or 18 wherein the permeable wall or wall section comprises particles which provide the permeability.
- 20 20. A container according to claim 19 wherein the particles are polyethylene, polypropylene or starch particles.
- 20 21. A container according to any one of the preceding claims which has at least two compartments, wherein the first compartment is sealed with a sealing member which comprises the second compartment within said sealing member.
- 25 22. A container according to claim 21 wherein the sealing member is a film.
- 30 23. A container according to claim 22 wherein the film contains a second compartment which has been formed by a vertical form fill sealing method.

24. A container according to claim 22 wherein the film contains a second compartment which has been formed by thermoforming.

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